CP 8990 – Option Paper
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Toward a Financially Sustainable Public Transportation Systems – The Effects of the Type of Service on Cost Efficiency.

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ABSTRACT

The extensive Eisenhower era highway system is reaching the end of its lifespan and will require a large investment in the coming years to keep functioning. History as shown that this extensive highway system is not solving the accessibility problems of our modern cities. Public transportation is making a resurgence as a potential solution. However, with little political willingness to downsize the system most of the Highway Trust Fund revenues are going toward the highway account, leaving public transportation systems with little money to expand. For the public transportation to strive, it either requires extra funding or it needs to be more efficient. This paper examines the correlation between transit system privatization and efficiency. The paper uses a series of regressions to determine if the efficiency, measured by the ratio of total operating expenses by vehicle revenue hour, is affected by the type of service (Directly operated, purchased transportation or mixed). The methodology is an update of McCullough's (1998) as it uses 2009 to 2013 data and introduces a variable to control for competition in the market. The results show that purchased transportation seemed to be associated with greater efficiency of the systems. Competition in the market is also significant and might be the real explanation behind purchase transportation being meaningful. However, when looking at the financial impact, the real driver of efficiency is scheduling.

This research is a comprehensive look at the relationships between transit systems privatization and cost efficiency. The first part of this research investigates the complex nature of privatizing bus services and highlights key factors of privatization that affect cost efficiency. A few cases from U.S. public transportation agencies and the U.K. deregulation policies from the 1980s are looked at. In the second part, the findings from the literature review are used to build a multiple regression model explaining the effect of several variables on agencies' cost efficiency. The hypothesis used to build the model is that purchased transportation and competition in the market contribute to a better cost efficiency.

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Gomez-Ibanez (2003) in his cycle of transit system life, explains how transit systems tend to go through the following ten phases:

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3. Regulation of fares and franchises
4. Decline in profitability
5. Withdrawal of capital and services
6. Public takeover
7. Public subsidies
8. Declining efficiency
9. Dilemma of subsidy cuts, fare increases, and service cuts
10. Privatization.

As explained in the history section (Section 2 - American Transit History) of this literature review, most of the transit systems in the United States are currently somewhere around phase 8 or 9. That includes the Metropolitan Atlanta's Rapid Transit Authority (MARTA). While several scenarios can happen, privatization is more and more often looked at as a way to drive efficiency up and reduce the amount of subsidies needed. The main concern with privatization is equity for the people in need of transit. Public transportation is often seen as a public good but is not technically one when looking at its economic definition. Section 3 (The Economic Argument for Privatization) makes the economical case for privatization and can be summarized by "a private management, motivated by the possibility of profit it is hoped, will have stronger incentives to control costs and thereby reduce or eliminate the need to support

the former state-owned enterprises and contracting or state supplied with scarce government tax revenues" (Gomez-Ibanez and Meyer 1993). Section 4 (System Privatization Impact Assessment) describes the pros and cons found in the literature when it comes to privatization. Finally, London is taken as a successful example of conversion to a privatized system. The last section will draw conclusions on privatization and recommend a set of data to collect to perform a multiple regression and test the hypothesis that agencies contracting out their local bus service are more cost efficient than public transit agencies that keep all of their operations in-house.

Since the late 1980s and until the advent of the private automobile, public transportation whether it was by horse-drawn carriages, streetcars or buses was the way to get around in most of the American cities. Often transit systems were going far beyond the boundaries of our current transit systems (Rodrigue 2013). Affordable and frequent, transit was used by people of all classes. Public transportation was then privately owned and operated but publicly regulated (Beimborn and Puentes 2005). Each operator paid the city for the use as well as wear and tear on the public roads. In the mid-1900s, after several decades of glory, privately owned transit companies entered an era of decline. Shortly after World War II, the automobile became affordable and cities started to sprawl out to the suburbs. One of the reasons for the success of the streetcars was also the underpaid labor (Gomez-Ibanez and Meyer 1993). Inflation rose rapidly and made operations less profitable by raising the operator's wages (Jones 2010). The ridership started to decline and so did the revenues (Wachs 1989). As a result, the Federal Government started to step-in to regulate public transportation and shift from a private ownership to a public ownership (Beimborn and Puentes 2005).

The 1960s

In 1961, Congressional approval of the Housing Act allowed modest loan programs to assist ailing commuter railroad companies (Hess and Lombardi 2005). Gradually, transit became public and required its own federal funding. In 1964, federal transit programs went from the Department of Commerce to the Department of Housing and Urban Development. The Urban Mass Transportation Act authorized $2.3 billion over 3 years in discretionary federal grants to cover up to two thirds of capital cost for the construction, reconstruction, or acquisition of transit facilities and

equipment (Hess and Lombardi 2005). While public transit was already declining, this attempt encouraged cities to build up their transit system. In 1968, Federal transit programs moved under the Department of Transportation. That is when the Urban Mass Transportation Administration (UMTA) that would later become the Federal Transit Administration (FTA) was created (Hess and Lombardi 2005).

The 1970s

By 1970, most cities were running their public transportation and funding was needed to maintain and operate the systems built using UMTA money. The Urban Mass Transportation Assistance Act (UMTAA) was voted to bring more funding to transit. Transit ridership was already declining rapidly, labor cost and fuel cost were rising leading to an inevitable transit service retrenchment in most U.S. cities (Altschuler and Luberoff 2003). In 1973, the Federal-aid Highway Act authorized highway funds to be more flexible and to allow use for non-highway capital projects. In 1974, after the strong lobbying of the transit industry, the National Mass Transportation Assistance Act was passed to secure funds for operating expenses. It boosted funding for discretionary gran. Funds were also distributed to urban areas on a formula basis and the 50% match for operating costs was used to defray maintenance and labor costs (Weiner 1999).

The 1980s

Between 1970 and 1980 the farebox recovery went from 70% to 30%. In 1982, the Surface Transportation Assistance Act introduced a 1p per gallon share of the gasoline tax. That revenue was transferred to the mass transit account of the highway trust fund to be used for the discretionary grant program (U.S. Congress 1982). In the same decade, the federal government decides to cut transit funding by 20% and the discretionary grant program was split, 40% for rail starts and extensions (New Start program), 40% to rail modernization, 10% to major bus project and 10% to discretionary funds. At the end of the 1980s, public transportation went from flourishing and private to public and struggling for money. While the automobile was making its way to American households, the federal government tried to encourage the development of transit systems by allocating large amount of money through discretionary grants. However, ridership was declining rapidly and the newly built systems quickly ran out of operating and

maintenance money while the federal government started to drastically cut funding. The financial burden was then gradually shifted to the local governments.

The 1990s

Despite the worsening of public transit systems, the 1990s have seen two major transportation bills the Intermodal Surface Transportation Efficiency Act (ISTEA, 1991) and the Transportation Equity Act for the 21st Century (TEA-21, 1998). These bills aimed at leveling the playing field between highway and transit funding by making it more certain, easier and flexible. More power was given to local governments (Beimborn and Puentes 2005). Between 1965 and 1996 operating costs in the public transportation industry have increased by 397% compared to an inflation rate of only 201%. Public transportation was the industry with the costs increasing at a faster rate than any other industry. As a result all of the revenues and subsidies were spent on operations and maintenance leaving nothing for expansion (Cox and Love 1996).

Post 2000

In 2005, George W. Bush signed into law the Safe, Accountable, Flexible, Efficient Transportation Equity Act: a Legacy for Users (Young 2005). The bill provided some record funding for transit including funds for the New Start and New Freedom programs. Both programs allocate funds for new transit systems and extensions. After the bill expired in 2009, it was renewed several times until Moving Ahead for Progress in the 21st Century Act (MAP-21) was passed in 2012 (Beimborn and Puentes 2005). MAP-21 streamlines the environmental review process to make project development faster. Some of the funding for pedestrian and bicycle was cut down and consolidated into a broader program “Transportation Alternatives”. More of the fund is transferred to the local Metropolitan Planning Organization (*Moving Ahead for Progress in the 21st Century* 2012).

The brief review of transit funding shows how transit was originally mostly private and successful. It then declined mostly due to the democratization of the automobile. The government, despite trying to encourage building out new transit systems, created an unleveled playing field between highway funding and transit funding (Beimborn and Puentes 2005). Soon after the incentive of building large systems was given federal funds were reduced leaving

the cities struggling for money to operate their system. More and more power is passed to the local authorities to operate and fund their systems. Public-private partnerships, infrastructure banks and the Transportation Infrastructure Finance and Innovation Act are more frequent to help funding transit systems.

The Economic Argument for Privatization

At the federal level, funding for transit is scarce. The gas tax that provides most of the money for the Highway Trust Fund has not changed since 1993 (Haven 2013) despite the increase in labor cost and decrease in gas tax revenue. The recent high inflation rate and better efficiency of cars have led to a reduction of the Highway Trust Fund (HTF) revenues. For each gallon of gasoline purchased 18.4 cents go to the HTF. Among these 18.4 cents, only 2.86 cents are allocated to the Transit Account. Confronted to the disregard of policy makers for transit, local governments and transit agencies explore new sustainable funding strategies for transit.

Imus, Baxandall and Christensen (2007) recognize seven principles for transit funding. It should enhance market efficiency and internalize the external costs. It should have a low collection cost. It should be reliable over time. It should have several sources rather than one. The approach should be 'How much can we charge before we start losing ridership' rather than a maximizing farebox recovery approach. It should be transparent and it should engage stakeholders. These principles highlight the importance of efficiency as well as the need for several sources of funding.

There is an extensive literature about funding streams proposals such as the 18 solutions of Litman (Litman 2014). Some of the solutions proposed include the traditional fare increases, taxes (property, sales, fuel, vehicle-km), advertising as well as some other that are not as widespread such as a levy on employees' wage, development impact fees or land value capture. While funding is critical, efficiency of the transit sector is also important. Privatization is often seen as a way to maximize efficiency but is rarely considered for public transportation in the U.S. One aspect of the funding problem for transit is to find the resources to pay for operations and maintenance but the other aspect that is not considered as often is 'How can we make our operations more efficient? Highway funding begins to look at privatization for congestion pricing and dial a ride services. Several American cities contracted out

these services to the private sector. The main arguments for non-privatization of transit systems are the equity problems that could arise as well as the fact that public transportation is considered as a public good. That is, non-excludable and non-rivalrous. Public goods are often provided by public monopolies. However, with monopolies consumers pay more for the service and get less out of it. Monopolies do not achieve market efficiency and interests of the service provider are favored to the interests of the consumer (Cox and Love 1996). Competitive markets seem to be what transit agencies want to aim for to lower costs and increase efficiency.

The following section looks at the pros and cons of privatization. Privatized transit is how transit started. Transit was then popular and used (4 – System Privatization Impact Assessment) by people from all classes and background. Why would that not hold true nowadays?

System Privatization Impact Assessment

This section looks at the advantages and disadvantages of privatized bus systems. The studies that were reviewed include systems that were either entirely privatized and ownership was transferred or others with partial privatization with agencies contracting out part of their service. In 2003, almost 40% of the 518 U.S. public transit agencies providing bus transit were contracting at least some of their service. When thinking about privatization or contracting out it is important to think about what type of service is concerned. Gomez-Ibanez distinguished between intra-urban service, radial (suburb to work trips) and inter suburban trips (Gomez-Ibanez and Meyer 1993). Some types of service are more tailored for privatization than others. For instance, if inter suburban routes are privatized there are high chances that operators will either not enter into contract or price the service really high due to the potentially low revenue per mile of the route.

Advantages

As mentioned before, introducing competition allows an increase in efficiency by balancing the market forces. It was reported that cost savings could be as high as 30% and some studies even mention 60% (Bladikas et al. 1992). Colorado was mandated in 1984 to contract out at least 20% of its system following an FTA requirement, the savings observed were of 31% using fully allocated costs (McCullough, Taylor, and Wachs 1998). One of the explanation

often cited for this increase in efficiency are the savings in labor cost and optimized utilization of the vehicle fleet. In the case where privatization is partial, it was observed that agencies contracting out some of the work became themselves more efficient (McCullough, Taylor, and Wachs 1998). In his study Babitsky looked at thirteen cases of private ownership in public transportation (Perry and Babitsky 1986). Six of the cases showed that private ownership was more efficient than public ownership, four cases showed opposite conclusions and the rest did not have a difference in efficiency. One of the major problems in the studies looking at difference in costs following a privatization are the correlation between the contracting decision and the cost efficiency, the non-differentiation between agencies that are entirely privatized and these that are only contracting out part of their service and finally the short length of time used for the studies. Iseki addressed all of these caveats in his research (Iseki 2010) and found that under particular conditions including competitive bidding, well-designed contracts and adequate management of the contractors privatization was more effective. Iseki highlighted that often 'contracting solves the inefficiency and ineffectiveness of publicly provided service caused by the swollen bureaucracies with redundant staff; high labor costs due to stringent work rules and limited use of part-time workers; and political pressure to provide service regardless of whether it is cost-efficient or cost-effective". Iseki found lower cost savings between 5% and 8% depending on the situation and the privatization model. Gomez Ibanez and Meyer looked at Denver and Houston among other cities that complied with the FTA requirement regarding contracting out (Gomez-Ibanez and Meyer 1993). The study finds that in general private firms are more efficient than public agencies, however the two authors did highlight the difficulty to control for other variables that might influence costs. They identified specifically four areas of cost savings, lower wages for drivers, lower driver fringes, lower overheads and lower maintenance costs.

Disadvantages

Numerous studies also raise concerns regarding potential disadvantages of having privatized or contracted out systems. It was noted that cost savings sometimes come at the expense of labor. Benefits for employees tend to be lower and their working hours longer. In Denver, drivers on routes that were contracted out were paid only 77% of what their public counterpart were (Peskin, Mundle, and Varma 1992). Threats of privatization cause labor to accept

lower working conditions whether it is in the public or private sector. It was highlighted that public agencies have a greater concern to keep the fares down and attract more customers compared to contracted-out routes that operate mostly on routes that are already heavily travelled on. Iseki is also concerned about the real administrative cost of managing the contractors when the service is not entirely privatized (Iseki 2010). In addition, poorly managed contracts that are not renegotiated often enough or enforced without meaningful performance indicator could lead to a decrease in efficiency. One the major concern for policy makers and regulators when considering privatization is the equity problems that could arise. Gomez-Ibanez and Meyer emphasized on it (Gomez-Ibanez and Meyer 1993). The assumption is that by introducing competition, low density communities will be disregarded and competition will occur only on a few profitable routes confusing customers with services redundancies and eventually encouraging auto use. Gomez-Ibanez also mentioned that private operators might care less about the quality of the service provided.

Conclusions

Studies seem to indicate that introducing privatization leads to more efficient transit systems, between 5% and 61% depending on the cases. Private entities are performance driven to maximize their return on investment while public entities tend to be less result oriented and more focused on service. In order to get a successful system both of these values should be integrated. It appears that one of the best way is to have a public entity managing the privatization to contractors while also keeping the service consistent and customer oriented through well-thought contracts. Each time a new service is added, transit agencies have to evaluate whether it is cheaper to do it in house or to contract it out. The bidding system when associated with well explained contract terms ensure that the service will be delivered in a way that is acceptable with the values of the transit agency. With the efficiency gained from contracting out the money saved along with the remained subsidies can help funding service routes that are lifeline service and that cannot be profitable. Some argue that these type of service should be subsidized by another branch of the government than transportation such as social services for example. Another important aspect that was emphasized by Cox and Love is the necessity for transparency in the privatization process. All parties should have access to all information for a fair and healthy competition environment (Cox and Love 1996). One problem that is not

really addressed in the studies is the decrease of working conditions and benefits for bus drivers. All privatization plans inevitably lead to drivers being worst off. This should be carefully considered when planning on going private. The key element for success is the careful monitoring of the contracting out and monitoring of the contractors. The following section is a brief case study of the London that started privatizing its service in the 1980s and that is considered one of the privatization success story.

Case Study of Great Britain

History of London Transit

Before 1984, public transportation was managed by London Transport (LT) and was reporting to the Greater London Council (GLC) since 1969. Between 1970 and 1982, London found itself losing riders to the automobile and entrenched in inflation leading to operating costs going up by two thirds (Kennedy 1995). That corresponds to step 4 (Decline in Profitability) in the Gomez-Ibanez cycle introduced in section 1. In the meantime grant payment went up from 6.5 Million to 370 Million. Between 1966 and 1984 the farebox recovery ratio went from 93% down to 58% (London Council 1985). In 1984, the London Regional Transport Act introduced a tendering system for the city of London to attempt saving the system. Following the Transportation Act, London Transport became a nationalized body and its control was transferred from the Greater London Council to the Secretary of State with the duty of providing public transport to the Greater London. The goal established for the remodeled agency was to reduce the subsidies by half the amount in three years and to increase service quality as well (Kennedy 1995). London Transport was also mandated to set up a company for providing public transportation, London Bus Limited (LBL) was then created.

The Tendering Process

London Transport Tendered Bus Division decided which route or set of routes to put out to tender. Specifications were detailed such as the bus capacity, the headway, the street and stands to be used for the service etc. Private operators then submitted sealed bids based on the service specification. The bid equaled the cost of providing the proposed service. Private operators could also suggest different bids with slightly different

specifications. London Bus Limited was also allowed to bid following the same rules as the private operators. It was required that all the bids estimate should yield a 5% minimum rate of return on turnover. The operator winning the bidding stages enters a three years contract monitored by the Tendering Bus Division. Any deviation from the contract could lead to financial penalties and termination of the contract (Kennedy 1995). Cost overrun were not subsidized and underperformance was deducted from the contract (Kennedy 1995a).

The Results of Privatization for London

Outcomes of the privatization are mixed. In terms of cost savings, Kennedy and Domberger observed significant decrease of operating costs when contracting out the service (Kennedy 1995). A regression was performed looking at cost as a function of bus velocity, age and size. The result was a saving of 18% and of 14% after administrative cost were deducted. Further cost savings were achieved through optimization in labor costs. Stakeholders' impact was also looked at. In general, workers in the industry were disadvantaged after privatization. Earnings were lower for bus drivers. The bus manufacturing industry had less orders due to operators stretching the life of their vehicles. The tax payers came out better-off with less taxes to pay due to a reduction in subsidies. The bus users were affected differently depending on where they lived. Overall there has been a decrease in patronage, however that could be attributed to people switching for automobiles as they become more affordable. Overall it was considered as a positive experience to privatize the system (White 1990). Interviews in Kennedy's studies mention that the simple process of restructuring the public entity to accommodate bus tendering allowed to streamline and make the agency more efficient resulting in cost savings (Kennedy 1995a). The heavily monitored tendering system organized by the public agency contributed to the efficiency of the system as well as allowing to retain equity in the system with an emphasis on customer service instilled by the public agency. As observed by Preston & Almutairi, 'competition for the market is preferable to competition in the market' (Preston and Almutairi 2014). This way it is ensured that bids will obey the market law and be priced correctly while retaining customer focus by not having multiple operators on one route resulting in confused customers.

Conclusion

Overall it seems that privatization in the form of contracting out bus service could be more efficient. It seems clear that cost savings could be achieved however to what extent is a question still to be answered. When Gomez-Ibanez compared the UK and the USA he found a lot of similarities to the exception of the United States being more productive now than the United Kingdom was then. Therefore productivity will be achieved better in matching the system to demand more closely (Gomez-Ibanez and Meyer 1993).The United States' transit is more subsidized than the United Kingdom's transit was therefore it is further away from viability. The level of auto ownership is also very different between the two countries. In the U.S. more people own car and the transit culture is lesser.

It is clear from the literature review that many factors come into play when evaluating the effectiveness of contracting-out bus services. McCullough et al. (1998) study provided an interesting analysis of the relation between the type of contracting and the cost-efficiency. McCullough's research will be updated and furthered by looking at the impact of competition on cost efficiency. As mentioned by Preston and Almutairi (2014) competition could be a major factor affecting an agency's efficiency.

METHODOLOGY

This paper uses McCullough et al's (1998) methodology as a starting point to show a potential evolution in how the type of service (Purchased, Directly Operated or Mixed) affects efficiency as well as taking it further by the introduction of new variables to refine the model. The hypothesis for this research and that is being tested is 'Are agencies that have some or all of their buses operations contracted out more efficient than agencies that directly operate all of the entirety of their bus service ?'. The new parameter introduced in this study is the presence of competition in the market. McCullough, after failing to demonstrate a correlation between the type of service and the efficiency of an agency, stated that efficiency might be driven by competition more than by the type of service. This hypothesis was also tested. The scope of this study is limited to local buses and does not include shuttle or paratransit services. McCullough et al. (1998) built a model to better define the relationships between efficiency and type of service ownership using the following variables:

• Cost efficiency
• Vehicle scheduling • Labor utilization • Cost-of-Living • Agency size • Vehicle size • Snowfall • Speed • Unionization • Population Density • Precipitation • Population • Service Area • Peaking • Contracting

Table 1- McCullough's Original Regression Model

This data was re-collected for 68 agencies across the U.S. (See Appendix A). In order to be selected for the data set, the agencies had to have over 100 buses in operation and should not have changed their Type of Service (TOS) between 2009 and 2013. The TOS is defined as either 'Directly Operated' (DO), 'Purchased Transportation' (PT) or Mixed. 'DO' and 'PT' are the abbreviations used by the National Transit Database (Federal Transit Administration 2015) while 'Mixed' describes agencies that have a combination of purchased transportation and directly operated transportation. The dataset comprises 38 agencies that directly operate their buses (DO), 11 that completely contract-out (PT) and 19 that do a bit of both (Mixed). Appendix B contains the list of each agencies along with a few of their attributes, including the type of service.

Since the paper was written in 1998, APTA stopped reporting a number of variables which prevents from totally recreating the data set McCullough et al. used. Consequently, the speed and vehicle size data is not included in this research but should not create any changes in the dataset as the study only looks at local bus service which is composed for the most part the trips of 40-feet buses within city limits. The contracting data collected is not recorded as the number of hours contracted-out but rather as a set of three dummy variables describing the nature of the contract. The number of hours contracted out matters much in this study, what is tested is whether or not there is an influence of the type of service on efficiency but not the intensity of the effect. The labor utilization measure was not utilized because it is only available for agencies that directly operate their buses.

All other variables were collected and averaged over a 5-year period (2009-2013) as it was done for the 1989-1993 by McCullough (1998) to avoid anomalies in agencies' operations skewing the dataset. The cost efficiency, used as a dependent variable, is the ratio of total operating expenses by vehicle revenue hour. The higher the value the more expenses per hour the agency is facing. The farebox recovery ratio was also added as an alternative efficiency measure. The farebox recovery ratio was not included in McCullough's studies, it was considered that the farebox recovery ratio was too closely related to the amount of demand for the service and therefore would not be a true measure of efficiency. However, for this study it was decided to be included in the regression as a measure reflecting how much of the expenses are covered by fares.

The vehicle scheduling measure is a ratio of total vehicle-hours by vehicle revenue hours and gives a sense of how well the vehicles are utilized for profit.

The 2014 cost of living data was extracted from the Council for Community and Economic Research website (The Council for Community and Economic Research, 2014). The Cost of Living Index (COLI) is used to control for the cost of life in each city. Wages and maintenance can be more costly in cities like New York or Chicago and lower in smaller cities like Columbus, OH. These differences in operating expenses could affect the result of the regression and are therefore controlled for with the Cost Of Living Index.

The size of the agency could also have an influence on the efficiency with large agencies spending more in administrative expenses while smaller agencies could spend a larger share of their revenue in maintenance. The agency size was accounted for using the number of vehicles operated in annual maximum service (VOMS).

The unionization rate was collected from the Union Membership and Coverage Database from the Current Population Survey (Hirsch, 2014). The unionization rate was used to account for potential differences in bus operators' wages. Agencies with unions are more likely to pay their drivers more, therefore the operation expenses would be higher regardless of the efficiency of the agency. The unionization rates for the public and private sectors were collected for each MSA included in this study.

The population density data was extracted from the National Transit Database and is used to account for the differences in the operating environment. Denser cities are assumed to be more cost efficient than sprawling cities. That variable helps controlling for service demand when using the farebox recovery ratio as a dependent variable.

The precipitation data was extracted from the National Oceanic and Atmospheric Administration database of the U.S. Department of Commerce (United States Department of Commerce, 2010). The data represents the 30-year average (1981-2010) for precipitation in inches. The data was collected for each cities included in this study.

The population and service area data were also extracted from NTD and was used in the calculation to determine the density of the study area.

Finally, the peak hour data was collected from the national transit database. Cities with lower peaking in their operations or without peak period are assumed to have lower expenses compared to the rest of the agencies that have an under-utilized bus fleet used to serve peak periods.

The last variable included that was not recorded in McCullough study is the number of competitors that each agency has. That data was extracted from the NTD has both an absolute value with an exact count of competitors

and also as dichotomous dummy variables (competitors or no competitors). The variables and their expected influence on the dependent variables are summarized in Table 1 below.

NAME	DESCRIPTION	INFLUENCE
DEPENDENT		
EFFICIENCY	Operations' Efficiency	
5YR_AVERAGEFBRECOVERYRATIO	Farebox Recovery Ratio	
INDEPENDENT		
VOMS	Vehicle Operated in Maximum Service	
COLI	Cost of Living Index	-
PRECIPITATION	Rain Precipitation (inches)	+
UNION	Unionization Rate (% of pop)	+
SERVICEAREAPOP	Population in the Service Area	-
SERVICEAREASQMI	Service Area in Square Miles	-
SERVICEAREADEN	Service Area Population Density	-
ISDO	Dummy variable for Directly Operated Transit	+
ISPT	Dummy variable for Purchased Transit	-
ISMIXED	Dummy variable for Mixed Type of Service	-
COMPETITORS	Number of Competitors	-
COMPETITORS_DUMVARYES	Dummy Variable for the presence of Competitors	-
COMPETITORS_DUMVARNO	Dummy Variable for the absence of Competitors	+
RH_RATIO	Scheduling Efficiency	-
PK2BASE	Magnitude of the Peak Service	+

Table 2 – Regression Variables Descriptive Statistics and Expected Signs

ANALYSIS

To test the hypothesis that agencies contracting-out part or the entirety of their bus services are more efficient than agencies that do not, a multiple regression using the aforementioned dataset was performed. The first model that was used is very similar to the McCullough's ones with the restrictions mentioned earlier, it is used to assess whether the situation has changed in 20 years. In 1988, McCullough et al. did not prove that the type of service affects the efficiency. Table 2 below shows the results of an updated model built by from McCullough's methodology.

Model Summary

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	0.821[a]	0.674	0.607	18.69134327

a. Predictors: (Constant), Is DO, VOMS, PK2BASE, Precipitation, Union, RH_RATIO, service area(sqmi), COLI, Is mixed, service area pop, Service area density.

Table 3 - Model 1 Summary

The model's R^2 is 0.607 compared to an R^2 of 0.84 for McCullough's model. That means 60.7% of the variation of the dependent variable is explained by the independent variables. Table 3 describes the effect of each variable in the model.

Coefficients[a]

Model	Unstandardized Coefficient		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std,. Error	Beta			Tolerance	VIF
(Constant)	240.490	71.310		3.372	.001		
RH_RATIO	-231.592	72.949	-.330	-3.175	.002	.558	1.791
COLI	0.364	.157	.345	2.320	.024	.273	3.661
VOMS	0.016	.007	.291	2.162	.035	.334	2.995
Union	0.487	.143	.339	3.418	.001	.613	1.630
Service area density	-.001	.001	-.137	-.844	.402	.231	4.333
Precipitation	.153	.182	.072	.838	.406	.808	1.238
Service area pop	-2.184E-6	.000	-.197	-1.325	.191	.272	3.679
Service area (sqmi)	-.005	.004	-.145	-1.127	.265	.367	2.723
PK2BASE	8.405	4.690	.159	1.792	.079	.768	1.302
Is mixed	16.932	8.662	.259	1.955	.056	.344	2.906
Is DO	14.517	9.257	.243	1.568	.123	.251	3.987

a. Dependent Variable: Efficiency

Table 4 - Model 1 Variables' coefficients

The scheduling efficiency, cost of living index, vehicle at maximum operated service, unionization rate are significant at the 95% confidence level while the peak-to-base ratio and dummy variable for mixed type of service are

insignificant with a value greater than 0.05. The collinearity table does not show any sign of multicollinearity between the variables (See Appendix C). RH_RATIO seems to have the largest impact on the efficiency measure. In this model, each increase of 0.01% in RH_RATIO yields a change of $ - 2.316/Hr in efficiency. In other terms, the lower the number of hours not in revenue hour the higher the efficiency. These results are very similar to what McCullough found in 1998 with the same significant variables except for the ones that were not included in this updated model (Vehicle size and Labor utilization). These two missing variables could explain the slightly lower adjusted R2 value of this updated model. This model also fails to prove that efficiency in a transit agency is influenced by the type of contract. The first conclusion that can be drawn from this first model is that it does not seem that practices have evolved too much in transit agencies and the same variables seem to be predominant in determining an agency's efficiency. The model also proves himself to be a reliable update of the 1998's model. Therefore the work of McCullough et al. can be used as a basis to build other models and further their research.

The next model uses the same independent variables but replaces the dependent variables by the farebox recovery ratio. The hypothesis is that the farebox recovery ratio might be a better measure for efficiency. Table 4 and 5 below summarize the results of that 2nd model.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.521[a]	.272	.123	.0815883234

Predictors: (Constant), Is DO, VOMS, PK2BASE, Precipitation, Union, RH_RATIO, service area (sqmi), COLI, Is mixed, service area pop, Service area density

Table 5-Model 2 Summary

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.026	.311		.084	.933		
RH_RATIO	.202	.318	.098	.633	.529	.558	1.791
COLI	.000	.001	-.157	-.709	.482	.273	3.661
VOMS	8.658E-5	.000	.544	2.709	.009	.334	2.995
Union	.001	.001	.260	7.750	.086	.613	1.630
Service area density	3.054E-6	.000	.177	.732	.467	.231	4.333
Precipitation	-.001	.001	-.156	-1.211	.231	.808	1.238
Service area pop	-1.018E-8	.000	-.315	-1.414	.163	.272	3.679
Service area (sqmi)	1.264E-5	.000	.125	.650	.518	.367	2.723
PK2BASE	.035	.020	.227	1.715	.092	.768	1.302
Is mixed	-.041	.038	-.214	-1.083	.284	.344	2.906
Is DO	-.026	.040	-.152	-.654	.516	.251	3.987

Dependent Variable: 5 Years average FBRecovRatio

Table 6 - Model 2 Variables' coefficients

This second model confirms the theory of McCullough (1998) that the farebox recovery ratio is not a good measure of efficiency while "Revenue hour normalizes operating conditions […] removes regional and modal biases in producing transit service". That model returns a really low adjusted R^2 of 0.123 with most of the variables being insignificant at the 90% confidence level. Given the results of this 2nd model the other regressions will use the efficiency measure rather than the farebox recovery ratio as a dependent variable.

Preston and Almutairi (2014) suggested that 'competition for the market is preferable to competition in the market'. This hypothesis could explain why there are beliefs that purchased transit leads to cost effectiveness, not because of contracting out itself but because it introduces competition. The 3rd model tests that hypothesis by introducing a competition variable into the model. If the model R^2 is high enough and if the competition variable is significant then the hypothesis will be verified. Model 3 and its results are presented in Table 6 and 7.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.830[a]	.689	.611	18.61040109
Predictos: (constant), PK2BASE, Is PT, service area (sqmi), Competitors Dummy Variable, COLI, Precipitation, Competitors, Union, RH_RATIO, Is mixed, VOMS, service area pop, Service area density				

Table 7 - Model 3 Results

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	248.109	72.676		3.414	.001		
RH_RATIO	-231.020	72.651	-.329	-3.180	.002	.558	1.791
COLI	.406	.159	.385	2.559	.013	.265	3.775
VOMS	.015	.007	.269	1.978	.053	.324	3.087
Union	.466	.143	.324	3.264	.002	.606	1.650
Competitors	.051	.622	.009	.082	.935	.481	2.079
Precipitation	.145	.187	.069	.774	.443	.763	1.311
Service area pop	-2.290E-6	.000	-.207	-1.280	.206	.229	4.367
Service area (sqmi)	-.005	.004	-.139	-1.080	.285	.361	2.768
Service area density	-.001	.001	-.174	-1.044	.301	.216	4.640
Is PT	-18.465	9.560	-.224	-1.931	.059	.447	2.239
Is Mixed	-1.433	7.385	-.022	-.194	.847	.469	2.130
Competitors Dummy variable	8.560	5.621	.135	1.523	0.134	.766	1.306
PK2BASE	8.348	4.698	.158	1.777	.081	.759	1.318

Dependent Variable: Efficiency

Table 8 - Model 3, Variables' coefficients

The model's R^2 is 0.611, it is a slight improvement from McCullough's model. Despite a greater R^2 the model does not proves the hypothesis that competition leads to an increased cost efficiency. The 'competitors dummy variable' is not significant in that model with a significance of 0.935. An analysis of the average efficiency for agencies that have competitors against those that do not have competitors supports that finding. The agencies without competitors have

an operating cost per hour of $110 on average while agencies with competitors have an operating cost of $122 per hour on average. Once again, RH_RATIO, COLI and Union come out as the most significant variables in the model. Both the VIF table and multicollinearity diagnostic show that there is no significant collinearity problem between the variables in the model. The B values show that RH_RATIO is by far the best explanatory variable in the model with a value of -231.02. That means that all other variable held constant an increase of 0.01% in RH_RATIO would lead to a decrease of $2.31/hour in operating expenses. The 'Is PT' variable is significant at the 90% confidence level meaning that purchased transportation type of service is more efficient by $18/Hr when looking at the efficiency variable. This model fails justifying the effect of competition on efficiency but it made the type of service variable significant at the 90% confidence level, demonstrating that all held constant and compared to directly operated service, purchased transportation increases the efficiency by $18 an per hour.

The dataset shows that none of the 23 less efficient agencies' bus services are 100% purchased transit. The averages for efficiency values tend to confirm that trend. The average efficiency for directly operated services is $120/Hr. and $98/Hr. for agencies that contract out 100% of their bus services. That is a difference of $22/Hr which is close to the $18/Hr. from the regression's output. The most expensive seems to be the mixed category with a value of $127/Hr.

Table 8 below shows the 10 most efficient agencies of the data set. The ranking is based on the revenue-hour ratio that was calculated from the National Transit Database information.

Name	State	VOMS	TOS	Efficiency_ Measure	COLI	Union	Is DO	FB_Recovery	Competitors	RH_ RATIO
LACMTA - Small Operators(LACMTA)	CA	184	PT	65.2	136.4	8	0	0.11	1	0.93
Toledo Area Regional Transit Authority(TARTA)	OH	78	DO	74.1	94.3	52.8	1	0.21	0	0.91
City of Tempe Transit Division - dba Valley Metro(TIM - Tempe in Motion)	AZ	106	PT	76.0	100.7	?	0	0.13	1	0.93
Interurban Transit Partnership(The Rapid)	MI	126	DO	78.1	90.7	47.2	1	0.17	0	0.96
Mass Transit Department - City of El Paso(Sun Metro)	TX	124	DO	78.5	90.4	22.2	1	0.19	1	0.96
Transportation District Commission of Hampton Roads, dba: Hampton Roads Transit(HRT)	VA	234	DO	80.6	111.7	16.2	1	0.23	0	0.99
Pinellas Suncoast Transit Authority(PSTA)	FL	173	Mixed	82.6	92.4	21.7	0	0.27	1	0.93
VIA Metropolitan Transit(VIA)	TX	352	DO	83.0	95.7	15.6	1	0.17	0	0.95
Riverside Transit Agency(RTA)	CA	117	Mixed	83.7	112.5	54.6	0	0.21	1	0.92
City of Tucson(COT)	AZ	210	DO	84.8	96.5	16.5	1	0.22	0	0.93

Table 9 - Top 10 of Most Efficient Agencies in the dataset

The top 10 (out of a total of 68) agencies do not seem to show any of the pattern reflected by the regression's outcome regarding competition of type of service. 5 of the agencies have competition. 5 agencies are a 'DO' while the remaining ones are 'PT' or 'Mixed'. However, the RH_RATIO is above 90% for all of them. It was also one of the most significant variable in the regression's outcome. The farebox recovery ratio (FB_Recovery) is low for most of the agencies. That means this agencies do not get a lot of revenue from the fares and use it optimally, has shown by the RH_RATIO values.

CONCLUSION

Multiple studies have analyzed the United Kingdom's experience in privatizing transit systems. Most studies concluded that privatization seemed to improve the efficiency of public transportation agencies. However, recent and older studies fail at accurately putting a number on that improvement. Several studies reviewed in the literature review provide really wide ranges to describe the gain in efficiency some going as wide as 5% - 61%. These wide ranges can lead to question the actual effect of privatization on the public transit systems. The literature review has clearly highlighted the complexity of the relationships between the variables that can potentially affect cost efficiency. In addition to the type of service (Directly Operated, Mixed or Purchased Transit), this study looked at the effect of competition on efficiency. The addition of the competition variable in the model made the 'purchased transit' type of

service variable significant at the 90% confidence level and showed an improvement of $18/hr. compared to directly operated transit. This was also confirmed by the analyses of each type of service groups' averages. The model's R^2 of 0.61 has moderate explaining power and the outcomes should be interpreted carefully. The purchased transportation variable is only significant at the 90% confidence level which would be considered the lowest acceptable. Looking at the top 10 most efficient agencies did not reveal a trend regarding competition or type of service. While the question of whether competition and type of service affect the performance of an agency remains, it is safe to say that if it does the effects are lower than other variables such as scheduling. The model has shown that greater savings can be accomplished by improving the scheduling. Each reduction of 1% in the vehicle revenue hours to vehicle-hours ratio yields a saving of approximately $2.31 per hour in efficiency. Improving scheduling is a measure that any agency can focus on while contracting can yield great benefits in some very particular cases but should not be applied as a general rule by transit agencies. The $18 savings per hour given by the model when comparing purchased transportation to directly operated transportation might be mostly explained by the fact that drivers tend to be paid significantly less in the private sector. Purchasing some transportation can be the solution for some agencies but as it was highlighted in the literature review, the contracts should be carefully written and monitored as well as revised frequently to gain the most benefits out of the transaction. Competition was believed to be stimulating for transit agencies and to make them become more efficient in the fear of losing market shares. There was no evidence of competition being an explanatory variable to the model. It might be due to the fact that competition comes at a price which might be reflected in the expenses and therefore in the efficiency of the agency.

The finding suggests that policies encouraging more competition in the market will have little effect on the public transit agencies' revenue. As it was shown in the literature review it might have a negative effect and degrade the working condition of many of the operators. As explained earlier, private operators tend to pay their employees less than public agencies. The cost of policies opening up the barriers to entry on the public transportation market would be too costly to implement when taking into account the amount of regulation and control that would be needed compared to the little financial return it would allow.

LIMITATIONS

In order to confirm the limited influence of contracting-out on transit agencies bus services' efficiency it would be useful to try to collect more data for agencies themselves in order to build a larger data set. The current dataset is only composed of 68 agencies and some of the results could be slightly off due to a fairly small dataset. Agencies should also be interviewed to know the exact nature of their contracts with third party transportation providers. As explained in the literature review there are several different ways of contracting transportation services out and the type of contract could be a new variable to add to this research.

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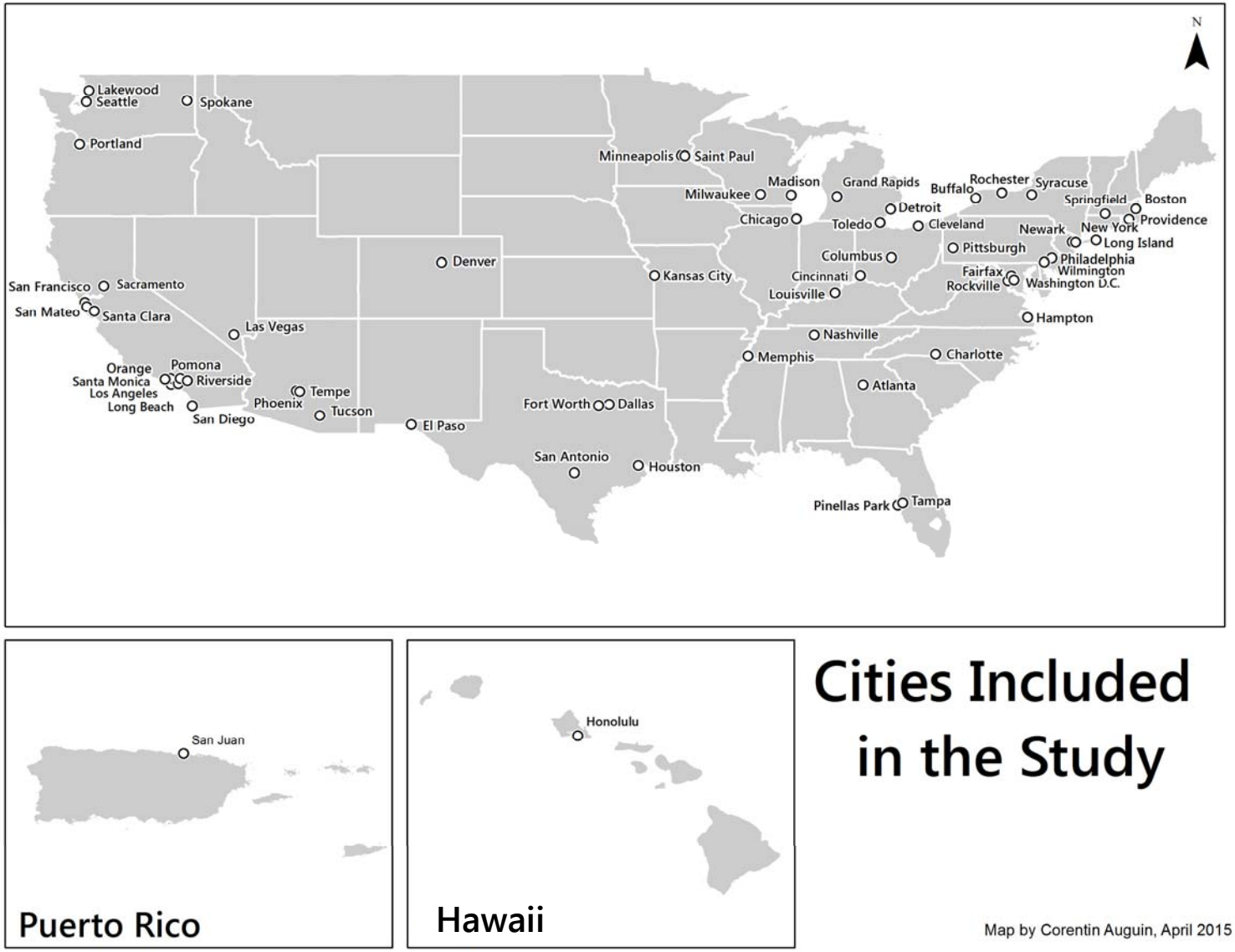
APPENDIX

Appendix A: Home Cities of the Selected Agencies.



Appendix B: Selected Agencies' List.

NAME	NTD ID	State	VOMS	TOS
City of Phoenix Public Transit Department dba Valley Metro(Valley Metro)	9032	AZ	392	PT
City of Tempe Transit Division - dba Valley Metro(TIM - Tempe in Motion)	9172	AZ	106	PT
City of Tucson(COT)	9033	AZ	210	DO
Regional Public Transportation Authority, dba: Valley Metro(RPTA)	9136	AZ	170	PT
Foothill Transit	9146	CA	266	PT
Golden Gate Bridge, Highway and Transportation District(GGBHTD)	9016	CA	166	Mixed
LACMTA - Small Operators(LACMTA)	9166	CA	184	PT
Long Beach Transit(LBT)	9023	CA	182	DO
Los Angeles County Metropolitan Transportation Authority dba: Metro(LACMTA)	9154	CA	1860	Mixed
Orange County Transportation Authority(OCTA)	9036	CA	428	Mixed
Riverside Transit Agency(RTA)	9031	CA	117	Mixed
Sacramento Regional Transit District(Sacramento RT)	9019	CA	158	DO
San Diego Metropolitan Transit System(MTS)	9026	CA	414	Mixed
San Francisco Municipal Railway(MUNI)	9015	CA	388	DO
San Mateo County Transit District(SamTrans)	9009	CA	265	Mixed
Santa Clara Valley Transportation Authority(VTA)	9013	CA	371	Mixed
Santa Monica's Big Blue Bus(Big Blue Bus)	9008	CA	152	DO
Denver Regional Transportation District(RTD)	8006	CO	819	Mixed
Washington Metropolitan Area Transit Authority(WMATA)	3030	DC	1338	Mixed
Delaware Transit Corporation(DTC)	3075	DE	187	Mixed
Hillsborough Area Regional Transit Authority(HART)	4041	FL	158	DO
Pinellas Suncoast Transit Authority(PSTA)	4027	FL	173	Mixed
Metropolitan Atlanta Rapid Transit Authority(MARTA)	4022	GA	446	DO
City and County of Honolulu Department of Transportation Services(DTS)	9002	HI	433	PT
Chicago Transit Authority(CTA)	5066	IL	1,663	DO
Pace - Suburban Bus Division(PACE)	5113	IL	600	Mixed
Transit Authority of River City(TARC)	4018	KY	178	Mixed
Massachusetts Bay Transportation Authority(MBTA)	1003	MA	784	Mixed
Pioneer Valley Transit Authority(PVTA)	1008	MA	137	PT
Ride-On Montgomery County Transit	3051	MD	281	DO
City of Detroit Department of Transportation(DDOT)	5119	MI	223	DO
Interurban Transit Partnership(The Rapid)	5033	MI	126	DO

Suburban Mobility Authority for Regional Transportation(SMART)	5031	MI	229	Mixed
Metro Transit	5027	MN	766	DO
Metropolitan Council	5154	MN	313	PT
Kansas City Area Transportation Authority(KCATA)	7005	MO	197	DO
Charlotte Area Transit System(CATS)	4008	NC	268	DO
New Jersey Transit Corporation(NJ TRANSIT)	2080	NJ	2029	Mixed
Regional Transportation Commission of Southern Nevada(RTC)	9045	NV	308	PT
CNY Centro, Inc. (CNY Centro)	2018	NY	123	DO
MTA Bus Company(MTABUS)	2188	NY	1,075	DO
MTA New York City Transit(NYCT)	2008	NY	3,306	DO
Niagara Frontier Transportation Authority(NFT Metro)	2004	NY	269	DO
Regional Transit Service, Inc. and Lift Line, Inc.(R-GRTA)	2113	NY	213	DO
Suffolk County Department of Public Works - Transportation Division(ST)	2072	NY	131	PT
Central Ohio Transit Authority(COTA)	5016	OH	261	DO
Southwest Ohio Regional Transit Authority(SORTA / Metro)	5012	OH	297	DO
The Greater Cleveland Regional Transit Authority(GCRTA)	5015	OH	350	DO
Toledo Area Regional Transit Authority(TARTA)	5022	OH	78	DO
Tri-County Metropolitan Transportation District of Oregon(TriMet)	0008	OR	505	DO
Port Authority of Allegheny County(Port Authority)	3022	PA	568	DO
Southeastern Pennsylvania Transportation Authority(SEPTA)	3019	PA	1,172	DO
Metropolitan Bus Authority(MBA)	4086	PR	114	DO
Rhode Island Public Transit Authority(RIPTA)	1001	RI	192	DO
Memphis Area Transit Authority(MATA)	4003	TN	120	DO
Metropolitan Transit Authority(MTA)	4004	TN	137	DO
Dallas Area Rapid Transit(DART)	6056	TX	527	DO
Fort Worth Transportation Authority(The T)	6007	TX	133	Mixed
Mass Transit Department - City of El Paso(Sun Metro)	6006	TX	124	DO
Metropolitan Transit Authority of Harris County, Texas(Metro)	6008	TX	766	Mixed
VIA Metropolitan Transit(VIA)	6011	TX	352	DO
Fairfax Connector Bus System(Fairfax Connector)	3068	VA	207	PT
Transportation District Commission of Hampton Roads, dba: Hampton Roads Transit(HRT)	3083	VA	234	DO
King County Department of Transportation - Metro Transit Division(King County Metro)	0001	WA	984	Mixed
Pierce County Transportation Benefit Area Authority(Pierce Transit)	0003	WA	106	DO
Spokane Transit Authority(STA)	0002	WA	114	DO
Metro Transit System(Metro)	5005	WI	175	DO
Milwaukee County Transit System(MCTS)	5008	WI	321	DO

Appendix C – Collinearity Diagnostic for Model 1

Collinearity Diagnostic[a]

Model	Eigenvalue	Condition Index	Variance Proportions											
			(Constant)	RH_RATIO	COLI	VOMS	Union	Service area density	Precipitation	service area pop	service area (sqmi)	PK2BASE	ls mixed	ls DO
1 1	8.508	1.000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	1.380	2.483	.00	.00	.00	.00	.00	.00	.00	.01	.03	.00	.05	.02
3	.892	3.088	.00	.00	.00	.06	.00	.05	.00	.03	.01	.00	.02	.00
4	.461	4.296	.00	.00	.00	.01	.00	.05	.01	.03	.11	.00	.13	.02
5	.190	6.686	.00	.00	.00	.17	.24	.03	.15	.00	.15	.01	.04	.00
6	.188	6.730	.00	.00	.00	.13	.17	.04	.00	.02	.05	.06	.19	.09
7	.112	8.734	.00	.00	.00	.47	.02	.10	.26	.19	.00	.09	.12	.04
8	.107	8.913	.00	.00	.00	.08	.07	.19	.02	.60	.49	.06	.01	.00
9	.081	10.248	.00	.00	.00	.01	.25	.01	.43	.01	.03	.08	.30	.45
10	.069	11.066	.00	.00	.01	.00	.09	.02	.12	.03	.02	.50	.00	.00
11	.010	28.748	.01	.02	.97	.06	.16	.43	.00	.06	.01	.02	.10	.34
12	.001	122.507	.99	.98	.00	.00	.01	.05	.00	.00	.10	.19	.05	.03

a. Dependent Variable: Efficiency